Calculating Clamping Voltage at Different Peak Pulse Currents

Transient voltage suppressor data sheets define clamping voltage at a specified maximum peak pulse current level. This application note describes how to interpolate the clamping voltage for transients currents other than the rated maximum.

Clamping Voltage Calculation

To determine the clamping voltage (Vc) of the TVS diode at an intermediate point between the breakdown voltage (V_{BR}) and the maximum clamping voltage ($V_{C\ MAX}$), a linear increase in Vc between V_{BR} and $V_{C\ MAX}$ is assumed. Therefore, the relationship between V_C and the test pulse current (I_P) is calculated using the following formula:

$$V_C = (I_P/I_{PP}) * (V_{C\ MAX} - V_{BR\ MAX}) + V_{BR\ MAX}$$

Where:
I_P = Test peak pulse current (Amps)
V_C = Intermediate clamping voltage at I_P (Volts)
I_{PP} = Rated maximum peak pulse current (Amps)
$V_{C\ MAX}$ = Maximum rated clamping voltage (Volts)
$V_{BR\ MAX}$ = Maximum rated breakdown voltage (Volts)

This calculation assumes a worse case condition where the device is at the maximum breakdown voltage limit and is therefore a conservative estimate across most of the distribution. If the value for $V_{BR\ MAX}$ is not stated on the device data sheet, it may be approximated by multiplying the minimum value by 1.25.

Example Calculation

An example of a calculated curve to one obtained through testing for an LC01-6 is shown in Figure 1. The LC01-6 data sheet specifies a minimum V_{BR} of 8 volts yielding a $V_{BR\ MAX}$ of 10 volts (1.25 * 8) for calculation purposes. Values are based on a maximum peak pulse current rating of 100A for a 10/1000µs impulse waveform. The experimental curve has a more shallow slope than the calculated curve, confirming the conservative rating of the device. Note that if I_P equals I_{PP} then V_C will equal $V_{C\ MAX}$.

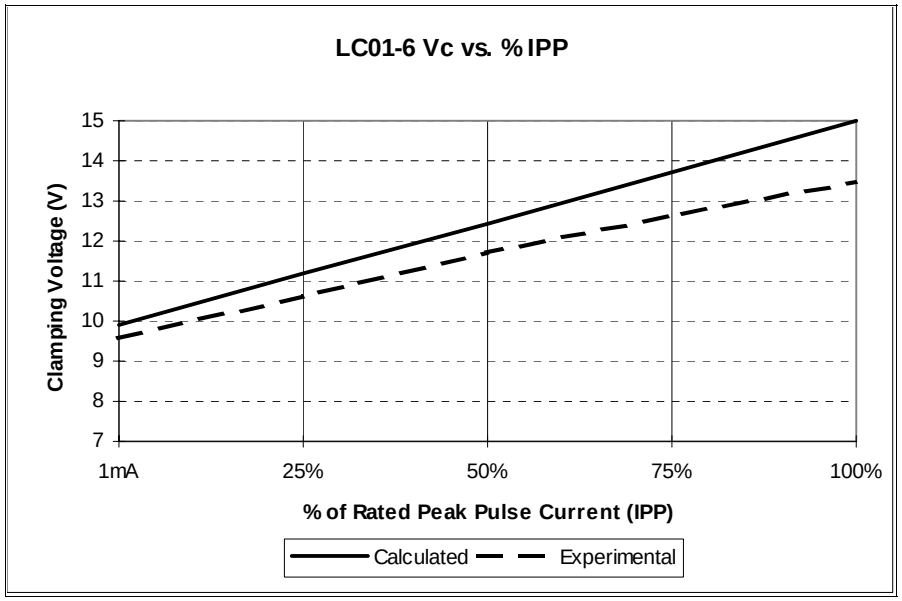

Figure 1 - LC01-6 Clamping Voltage vs. % Peak Pulse Current